International Journal of Engineering Research
Volume No.5 Issue: Special 5, pp: 992-1128
ISSN: 2319-6890)(online),2347-5013(print)
20 May 2016

ANTI-COLLISION OF VEHICLES BY AUTOMATED SPEED & STEERING CONTROL

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Abstract: Many accidents at high ways are taking place due to close running of the vehicles all of sudden. If front vehicle driver reduces the speed or apply the brakes, then it is not possible to follow rear vehicle driver to control his vehicle, and it leads to a collision of vehicles. This can be avoided by providing the warning system at rear side of each and every vehicle. Here vehicles are controlled automatically without any manual operation when it is at a minimum distance away from the obstacle, and also it provides the alarm alert to driver in extreme condition. It can also be used to increase the speed automatically as the traffic gets cleared. If this automation fails under any circumstances then the system changes over to normal manual control without affecting the performance of the vehicle.

Key Words: Ultrasonic Sensor, Arduino, Arduino IDE Software, Accelerator, DC Motor, Liquid Crystal Display, Potentiometer, Anti-lock Braking System, Power Steering System.

I. Introduction

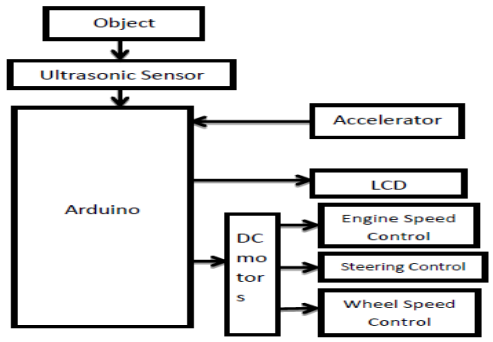
According to World Health Organizations, road accidents annually cause approximately 1.2 million deaths worldwide; one fourth of all deaths caused by injury. Also about 50 million persons are injured in traffic accidents. This has motivated me to carry out this project. The main objective of this project is to develop a system to keep the vehicle secure and protect it from collisions by automatic speed control, steering control and accident avoidance using the ultrasonic sensors. Whenever an obstacle is detected by ultrasonic sensor it depends upon the distance to automatically control the speed and direction of the vehicle. If the driver is in drowse condition and do not control the speed and direction of the vehicle then the controller do it on its own and drives an alarm alert for the driver.

II. Issues of Existing Control System

Control System in vehicle mainly required for speed and direction. Now a days vehicle are coming with anti-lock braking system and power steering. Antilock breaking system provides smooth breaking under any road condition depending upon the pressure applied on it by the driver. Power steering reduces the human effort to control the direction. Normal problems faced by driver during the driving are:

1. Breaking: ABS can provide effective breaking under any conditions but it is not automated moreover it takes time to stop the vehicle by reducing the wheel speed. It mainly avoids the skidding of vehicle. But it can't avoid accidents due to driver mindset and it is dependent of manual operation.
2. Steering: Power steering controls the direction of the vehicles by reducing the human effort in steering of the vehicle. As it is also not automated it depends on the human interaction to control the direction of the vehicle. If the driver fails to control steering it will also leads to an accidents.
3. Engine speed: Engine speed mainly depends upon the air fuel ratio allowed into the cylinder. Air fuel ratio is mainly controlled by driver using an accelerator that controls the position of the throttle plate to maintain the desired quantity of air fuel into the engine such that the crankshaft rotates at certain desired speed.

III. Functional Block Diagram



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IV. Modules Involved

A. Ultrasonic Sensor

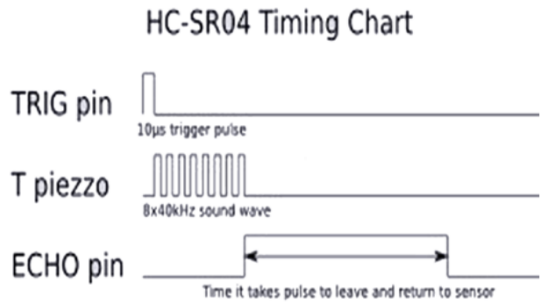
It is an electromechanical device used to measure the range of the target object.

The basic principle of work:

1. Using IO trigger for at least 10us high level signal,
2. The Module automatically sends eight 40kHz ultrasonic sound wave and detect whether there is a pulse signal back.
3. If the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.
4. Range of the target = (high level time * velocity of ultrasonic sound wave (340M/S)) / 2.

Features:

Voltage	DC 5 V
Current	15mA
Frequency	40kHz
Max Range	4m
Min Range	2cm
Measuring Angle	15 degree
Trigger Input Signal	10uS TTL pulse
Echo Output Signal	Input TTL lever signal & the range in proportion
Resolution	0.3cm



Role: It is used to measure the range of the target object or obstacle in front of the vehicle.

B. Liquid Crystal Display

A liquid crystal display is special thin flat panels that can let light go through it, or can block the light. The panel is made up of several blocks, and each block can be in any shape. Each block is filled with liquid crystals that can be made clear or solid, by crystal displays are often abbreviated LCDs. Liquid crystal displays are often used in battery-powered devices, such as digital watches, because they use very little electricity. They are also used for flat screen TV's. Many LCDs work well by themselves when there is other light around it also. For smartphones, computer monitor, TV's and some other purposes, a back- light is built into the product.

Role: It is used to display the range of the target object or obstacle measured by the ultrasonic sensor.

C. Microcontroller

Arduino is an controller which is an open-source electronics platform based on easy-to-use hardware and software. It's intended for anyone making interactive projects. It senses the environment by receiving inputs from many sensors, and affects its surroundings by controlling lights, motors and other actuators.

Input and Output Pins Details:

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kΩ. In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value by attachInterrupt() function.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).
- These pins support SPI communication using the SPI library.

doi : 10.17950/ijer/v5i5/029

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- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the
- LED is on, when the pin is LOW, it's off.
- The Uno has 6 analog inputs, labeled A0 to A5, each of which provide 10 bits of resolution. By default they measure from ground to 5 volts,
  though is it possible to change the upper end of their range using the AREF pin and the analogReference() function.

Additionally, some pins have specialized functionality:

- TWI: A4 or SDA pin and A5 or SCL pin.
- Support TWI communication using the Wire library.
- AREF: Reference voltage for the analog inputs.Used with analogReference().
- Reset: Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Role: It is used to process the data obtained from ultrasonic sensor and to actuate the automated speed and steering control depending upon the range of the target object or obstacle.

Features:

Microcontroller	ATmega328
Input Voltage	7-12V
Operating Voltage	5V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB of which 0.5 KB used by bootloader
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz

D. DC Motor

It is electrical device used to convert electrical energy into mechanical energy.

Since, $E_a = V_t - I_aR_a$ and $E_a = K_a\varphi\omega_m$, Therefore, $\omega_m = (V_t - IaRa)/K_a\varphi$.

Speed control is required in any types of motors to obtain the sufficient torque in order to handle the load. Practically, speed control of DC motors can be fulfilled using one of two methods:

- Field Current Control: This can be achieved by varying the field current through the field coil.
- Armature Voltage Control: By varying the terminal voltage across the terminals of the motor armature coil.

Up to the rated (base) speed the armature and the field currents are kept constant to maintain the torque at its rated value. The speed control within this range is carried out by varying the armature voltage. Beyond the base speed, the speed control the achieved by varying the field current. Within this range, the motor power is maintained constant and the torque is reduced with the increase in the rotational speed. For series motor, the speed control beyond the base speed is carried out using the armature current variation (since the armature and the field current are the same in series motors).for s

Role: The three DC motors are used to obtain the following controls in the vehicle:

1. Engine speed control.
2. Wheel speed control.
3. Steering control.

E. Accelerator (Potentiometer)

It is a three terminal electrical device with sliding or rotating contact that forms an adjustable voltage divider. It is mainly used for measuring an electromotive force by balancing it against the potential difference produced by passing a known current through a known variable resistance. It has two strips made on it resistive and conductive. Resistive strip is made of carbon and is responsible for resistance variance. Conductive strip helps the pot to carry the current into the circuit in accordance with the resistance. It is used as volume knob in music systems, as fan regulators, etc.

Parts of potentiometer:

1. Lugs: by convention there three lugs (1, 2, and 3).

2. Shaft: is a plastic or metallic stick used to turn the pot.
3. Resistive strip: is the heart of the pot. It is a carbon strip that is printed on phenolic strip.
4. Metal wiper: connector that connects the lug 1 and lug 2.

Role: Potentiometer is used to obtain the acceleration effect of the vehicle. Accelerator mainly provides the positioning of the throttle plate, here potentiometer also gives the same effect in prototype.

V. Working

The speed of vehicle mainly depends upon the air fuel ratio entering into the engine cylinder which is controlled by the driver using the accelerator pedal which maintains the positioning of the throttle plate. The speed transferred to wheels is twice the engine speed as engine completes one cycle if crank shaft rotates twice. Engine cycle speed depends upon the hot gases created inside the cylinder which depends on air fuel ratio entering into the cylinder. Hence by controlling the air fuel ratio engine speed can be controlled this in turn controls speed transferred to the wheels of the vehicle. Another method to obtain the speed control is by breaking. Braking reduces the speed in any situation independent of the air fuel ratio entering into the engine. Steering wheel is used to get the direction control of the vehicle.

Control system takes the action under three conditions depending upon the distance measured. Ultrasonic sensor continuously sends the signals and monitors any other cars or obstacles which are in front of the vehicle.

Conditions under which control works:

1. If the distance measured is greater than 30cm, then the controller will not take any action. The speed and steering control is completely under the influence of the driver itself as vehicle is too far away from the obstacles that will not lead to an accident.

2. If the distance measured is in the range of 15cm to 30 cm, then the controller initiates the automation to control the speed of the vehicle but it will not initiate the steering control. Hence by this it will reduce the time required for accident as speed reduces.

3. If the distance measured is less than 15cm, then the controller sends signals to the motors to monitor speed and steering control of the vehicle. Also controller drives an alarm alert to indicate the possibility of accident the vehicle also.

This process repeats continuously to avoid accidents even in extreme conditions if the driver fails to control it.

VI. Future scope

- Automatically analyzing the traffic signs.
- Reading signals are possible by incorporation of cameras in the vehicles.
- Emission of warning signals directly from the traffic boards can be directly read by the receivers in the vehicles.
- Introducing the vehicle to vehicle communication with LIFI technology still better performance can be achieved.
- As the Braking & Steering is controlled by microcontroller we can use same controller to provide the security system by locking the steering & wheels.

VII. Conclusion

By implementing this system in the vehicles accidents can be minimized as much as possible even if the driver fails to control the vehicle in drowse conditions. The vehicle can be protected that not cause too much of loss to driver due to the accident.

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